ANNEX 1 Key Category Analysis

The United States has identified national key categories based on the estimates compiled in this report. The *2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (IPCC 2006) and the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2019) describes a key category as a "… inventory categories which individually, or as a group of categories (for which a common method, emission factor and activity data are applied) are prioritized within the national inventory system because their estimates have a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level, the trend, or the level of uncertainty in emissions or removals. Whenever the term key category is used, it includes both source and sink categories." By definition, key categories are sources or sinks that have the greatest contribution to the absolute overall level of national emissions and removals in any of the years covered by the time series. In addition, when an entire time series of emission and removal estimates is prepared, a determination of key categories must also account for the influence of the trends of individual categories. Therefore, a trend assessment is conducted to identify source and sink categories for that may not be large enough to be identified by the level assessment, but whose trend contributes significantly to the overall Inventory trend (IPCC 2019). Finally, a qualitative evaluation of key categories should be performed, in order to capture any key categories that were not identified in either of the quantitative analyses, but can be considered key because of the unique country-specific estimation methods.

The methodology for conducting a key category analysis, as defined by Volume 1, Chapter 4 of the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2006) and *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2019), includes:

- Approach 1 (including both level and trend assessments);
- Approach 2 (including both level and trend assessments, and incorporating uncertainty analysis); and
- Qualitative approach.

This Annex presents an analysis of key categories, both for sources only and also for sources and sinks (i.e., including Land Use, Land-Use Change and Forestry LULUCF); discusses Approach 1, Approach 2, and qualitative approaches used to identify key categories for the United States; provides level and trend assessment equations; and provides a brief evaluation of IPCC's quantitative methodologies for defining key categories. The UNFCCC common reporting format (CRF) reporting software generates Table 7, which also identifies key categories using an Approach 1 analysis based on the default disaggregation approach provided in Volume 1, Chapter 4, Table 4.1 of the *2006 IPCC Guidelines*, and includes special considerations for further disaggregation by fuel type for fuel combustion categories. The disaggregation of categories presented in CRF Table 7 and this annex vary but the results of the key category analysis are consistent. Consistent with the UNFCCC reporting guidelines, the United States key category analysis uses the IPCC suggested aggregation level as the basis for the analysis, but in some cases the disaggregation does differ. Differences arise from implementation of special considerations identified in Table 4.1. As stated in section 4.2 in Volume 1, Chapter 4 of the *2006 IPCC Guidelines*, "…countries using Approach 2 will probably choose the same level of aggregation that was used for the uncertainty analysis." In order to retain consistency in the categorization with the uncertainty analysis, the aggregation level for this analysis (i.e. Approach 1, 2 etc.) does reflect some but not all special considerations such as disaggregating for significant subcategories (e.g., for 1.A.1, 3.A, 3.B) and fuel types for the following categories: Fuel Combustion Activities—Water-borne Navigation (1.A.3.d), Fuel Combustion Activities—Other Sectors (1.A.4), Fugitive Emissions from Fuels –Oil (1.B.2.a) and Natural Gas (1.B.2.b), Petrochemical and Carbon Black Production (2.B.8), Direct and Indirect N_2O Emissions (3.D.1 and 3.D.2), land use categories (4.A, 4.B, 4.C, 4.D, 4.E, and 4.F), Solid Waste Disposal (5.A) and Wastewater (5.D). Most other differences stem from additional disaggregation to subcategories consistent with the uncertainty analysis, including within Fuel Combustion Activities—Other Sectors (1.A.4.a Commercial/Institutional and 1.A.4.b Residential), Fossil Fuel Combustion—Non-Specified Stationary (1.A.5.a Incineration of Waste, Non-Energy Use of Fossil Fuels, and U.S. Territories) and Mobile (1.A.5.b Military), Biomass Burning (4.A(V) Forest Fires and 4.C(V) Grass Fires), and Biological Treatment of Solid Waste (5.B.1 Composting and 5.B.2 Anaerobic Digestion at Biogas Facilities). As EPA disaggregates the uncertainty analysis, it will reflect these special considerations in aggregation levels of the key category analysis. Finally, in addition to conducting Approach 1 and 2 level and trend assessments, a qualitative assessment of categories, as described in the *2006 IPCC Guidelines* and the *2019 Refinement to the 2006 IPCC Guidelines,* was conducted to capture any key categories that were not identified by either quantitative method. For this Inventory, no additional categories were identified using criteria recommend by IPCC, but EPA continues to review its qualitative assessment on an annual basis.

Table A-1 summarizes key categories for the United States (including and excluding LULUCF categories) ranked according to their sector and CO_2 Eq. emissions and/or removal estimate in 2021. The table also indicates the criteria used in identifying these categories as key (i.e., Approach 1 level/trend, Approach 2 level/trend, and/or qualitative assessments).

Table A-1: Summary of Key Categories for the United States (1990 and 2021) by Sector

CRF Code and Source/Sink Category	Greenhouse Gas	Approach 1				Approach 2				2021 Emissions (MMT CO_2 Eq.)	Level A1 Ranking With LULUCF[a]	Level A1 Ranking Without LULUCF[b]
		Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF	Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF			
Energy												
1.A.3.b CO_2 Emissions from Transportation: Road	CO_2	•	•	•	•	•	•	•	•	1,456.3	1	1
1.A.1 CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	•	•	•	•	•	•	•	•	909.9	2	2
1.A.1 CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	•	•	•	•	•	•	•	•	612.9	4	3
1.A.2 CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	•	•	•	•	•	•	•	•	499.6	5	4
1.A.4.b CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	•	•	•	•	•		•		258.6	7	6
1.A.2 CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	•	•	•	•	•	•	•	•	232.9	8	7
1.A.4.a CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	•	•	•	•	•	•	•	•	180.9	11	10
1.A.3.a CO_2 Emissions from Transportation: Aviation	CO_2	•	•	•	•	•	•	•		153.3	12	11
1.A.5 CO_2 Emissions from Non-Energy Use of Fuels	CO_2	•	•	•	•	•	•	•	•	140.2	13	12
1.A.3.e CO_2 Emissions from Transportation: Other	CO_2	•	•	•	•		•			64.2	19	15
1.A.4.b CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	•	•	•	•		•		•	54.7	21	16
1.A.4.a CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	•	•	•	•					50.7	22	17

CRF Code and Source/Sink Category	Greenhouse Gas	Approach 1				Approach 2				2021 Emissions (MMT CO_2 Eq.)	Level A1 Ranking With LULUCF[a]	Level A1 Ranking Without LULUCF[b]
		Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF	Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF			
1.A.2 CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	•	•	•	•	•	•	•	•	43.0	26	20
1.A.3.d CO_2 Emissions from Transportation: Domestic Navigation	CO_2	•		•						41.2	29	23
1.B.2 CO_2 Emissions from Natural Gas Systems	CO_2	•		•						36.2	31	25
1.A.3.c CO_2 Emissions from Transportation: Railways	CO_2	•		•						32.2	33	27
1.B.2 CO_2 Emissions from Petroleum Systems	CO_2	•	•	•	•		•		•	24.7	37	30
1.A.1 CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	•	•	•	•	•	•		•	17.7	41	33
1.A.5 CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	•		•						17.0	43	35
1.A.5.b CO_2 Emissions from Transportation: Military	CO_2		•		•					5.2	55	44
1.A.4.a CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2		•		•					1.4	59	48
1.A.4.b CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2						•		•	0.0	61	50
1.B.2 CH_4 Fugitive Emissions from Natural Gas Systems	CH_4	•	•	•	•	•	•	•	•	181.4	10	9
1.B.2 CH_4 Fugitive Emissions from Petroleum Systems	CH_4	•		•		•				50.2	23	18
1.B.1 CH_4 Fugitive Emissions from Coal Mining	CH_4	•	•	•	•	•	•	•	•	44.7	25	19
1.B.2 CH_4 Fugitive Emissions from Abandoned Oil and Gas Wells	CH_4					•		•		8.2	52	41
1.A.4.b CH_4 Emissions from Stationary Combustion - Residential	CH_4					•	•	•	•	4.6	56	45

CRF Code and Source/Sink Category	Greenhouse Gas	Approach 1				Approach 2				2021 Emissions (MMT CO_2 Eq.)	Level A1 Ranking With LULUCF[a]	Level A1 Ranking Without LULUCF[b]
		Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF	Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF			
1.A.1 N_2O Emissions from Stationary Combustion - Coal - Electricity Generation	N_2O					•				15.1	46	37
1.A.3.b N_2O Emissions from Transportation: Road	N_2O	•	•	•	•	•	•		•	9.4	50	40
1.A.1 N_2O Emissions from Stationary Combustion - Gas - Electricity Generation	N_2O						•			3.9	57	46
Industrial Processes and Product Use												
2.C.1 CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	•	•	•	•	•	•	•	•	41.7	27	21
2.A.1 CO_2 Emissions from Cement Production	CO_2	•	•	•	•					41.3	28	22
2.B.8 CO_2 Emissions from Petrochemical Production	CO_2	•	•	•	•					33.2	32	26
2.B.3 N_2O Emissions from Adipic Acid Production	N_2O		•		•					6.6	53	42
2.F.1 Emissions from Substitutes for Ozone Depleting Substances: Refrigeration and Air conditioning	HFCs, PFCs	•	•	•	•	•	•	•	•	139.1	14	13
2.F.4 Emissions from Substitutes for Ozone Depleting Substances: Aerosols	HFCs, PFCs	•	•	•	•	•	•	•	•	17.7	42	34
2.F.2 Emissions from Substitutes for Ozone Depleting Substances: Foam Blowing Agents	HFCs, PFCs		•		•					10.8	48	39
2.G SF_6 and CF_4 Emissions from Electrical Transmission and Distribution	SF_6, CF_4	•	•	•	•		•		•	6.0	54	43
2.B.9 HFC-23 Emissions from HCFC-22 Production	HFCs	•	•	•	•		•		•	2.2	58	47
2.C.3 PFC Emissions from Aluminum Production	PFCs	•	•	•	•					0.9	60	49
Agriculture												

CRF Code and Source/Sink Category	Greenhouse Gas	Approach 1				Approach 2				2021 Emissions (MMT CO_2 Eq.)	Level A1 Ranking With LULUCF[a]	Level A1 Ranking Without LULUCF[b]
		Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF	Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF			
3.A.1 CH_4 Emissions from Enteric Fermentation: Cattle	CH_4	•	•	•	•	•	•	•		188.2	9	8
3.B.1 CH_4 Emissions from Manure Management: Cattle	CH_4	•	•	•	•	•	•		•	37.9	30	24
3.B.4 CH_4 Emissions from Manure Management: Other Livestock	CH_4	•		•	•					28.1	35	29
3.C CH_4 Emissions from Rice Cultivation	CH_4	•				•		•		16.8	44	36
3.D.1 Direct N_2O Emissions from Agricultural Soil Management	N_2O	•		•		•	•	•	•	264.7	6	5
3.D.2 Indirect N_2O Emissions from Applied Nitrogen	N_2O	•		•		•		•		29.3	34	28
Waste												
5.A CH_4 Emissions from MSW Landfills	CH_4	•	•	•	•	•	•	•	•	103.7	16	14
5.A CH_4 Emissions from Industrial Landfills	CH_4	•		•		•	•		•	18.9	40	32
5.D CH_4 Emissions from Domestic Wastewater Treatment	CH_4					•				13.9	47	38
5.D N_2O Emissions from Domestic Wastewater Treatment	N_2O	•		•		•	•	•	•	20.4	38	31
Land Use, Land-Use Change, and Forestry												
4.E.2 Net CO_2 Emissions from Land Converted to Settlements	CO_2			•	•			•	•	81.0	18	NA
4.B.2 Net CO_2 Emissions from Land Converted to Cropland	CO_2			•				•		56.5	20	NA
4.C.1 Net CO_2 Emissions from Grassland Remaining Grassland	CO_2							•	•	10.0	49	NA
4.B.1 Net CO_2 Emissions from Cropland Remaining Cropland	CO_2			•				•	•	(18.9)	39	NA
4.C.2 Net CO_2 Emissions from Land Converted to Grassland	CO_2			•	•			•	•	(24.7)	36	NA
4.A.2 Net CO_2 Emissions from Land Converted to Forest Land	CO_2			•				•		(98.3)	17	NA
4.E.1 Net CO_2 Emissions from Settlements Remaining Settlements	CO_2			•	•			•	•	(134.5)	15	NA

CRF Code and Source/Sink Category	Greenhouse Gas	Approach 1				Approach 2				2021 Emissions (MMT CO_2 Eq.)	Level A1 Ranking With LULUCF[a]	Level A1 Ranking Without LULUCF[b]
		Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF	Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF			
4.A.1 Net CO_2 Emissions from Forest Land Remaining Forest Land	CO_2			•	•			•	•	(695.4)	3	NA
4.D.1 CH_4 Emissions from Flooded Lands Remaining Flooded Lands	CH_4			•						45.4	24	NA
4.A.1 CH_4 Emissions from Forest Fires	CH_4				•				•	15.5	45	NA
4.A.1 N_2O Emissions from Forest Fires	N_2O								•	8.9	51	NA
Subtotal of Key Categories Without LULUCF[c]										**6,171.7**		
Total Gross Emissions Without LULUCF										**6,340.2**		
Percent of Total Without LULUCF										**97%**		
Subtotal of Key Categories With LULUCF[d]										**5,384.5**		
Total Net Emissions With LULUCF										**5,586.0**		
Percent of Total With LULUCF										**96%**		

NA (Not Applicable)

[a] Key Category Ranking is shown for both the Level Approach 1 With LULUCF, and Level Approach 1 Without LULUCF analyses in line with the recommendations of the *2019 Refinement*, Volume 1, Chapter 4, Section 4.4. LULUCF sector rankings are not applicable in the Level Approach 1 Without LULUCF analysis, denoted in the table by NA. Rankings for trend analysis are located in the Annex 1 supplemental files available online at https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021.

[b] Other includes emissions from pipelines.

[c] Subtotal includes key categories from Level Approach 1 Without LULUCF, Level Approach 2 Without LULUCF, Trend Approach 1 Without LULUCF, and Trend Approach 2 Without LULUCF.

[d] Subtotal includes key categories from Level Approach 1 With LULUCF, Level Approach 2 With LULUCF, Trend Approach 1 With LULUCF, and Trend Approach 2 With LULUCF.

Note: Parentheses indicate negative values (or sequestration).

Table A-2 provides a complete listing of categories by CRF code/sector, along with notations on the criteria used in identifying key categories, excluding the LULUCF sources and sinks. Similarly, Table A-3 provides a complete listing of source and sink categories by CRF code/sector, along with notations on the criteria used in identifying key categories, including LULUCF sources and sinks. The notations refer specifically to the year(s) in the Inventory time series (i.e., 1990 to 2021) in which each source or sink category reached the threshold for being a key category based on either an Approach 1 or Approach 2 level assessment.

Table A-2: U.S. Greenhouse Gas Inventory Source Categories without LULUCF

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
Energy						
1.A.3.b CO_2 Emissions from Transportation: Road	CO_2	1,157.4	1,456.3	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.1 CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	1,546.5	909.9	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.1 CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	175.4	612.9	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.2 CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	407.4	499.6	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.4.b CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	237.8	258.6	•	L_1 T_1 L_2	1990, 2021
1.A.2 CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	287.1	232.9	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.4.a CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	142.0	180.9	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.3.a CO_2 Emissions from Transportation: Aviation	CO_2	187.2	153.3	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.5 CO_2 Emissions from Non-Energy Use of Fuels	CO_2	112.4	140.2	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.3.e CO_2 Emissions from Transportation: Other	CO_2	36.0	64.2	•	L_1 T_1 T_2	1990_1, 2021_1
1.A.4.b CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	97.8	54.7	•	L_1 T_1 T_2	1990_1, 2021_1
1.A.4.a CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	74.3	50.7	•	L_1 T_1	1990_1, 2021_1
1.A.2 CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	157.8	43.0	•	L_1 T_1 L_2 T_2	1990, 2021_1
1.A.3.d CO_2 Emissions from Transportation: Domestic Navigation	CO_2	39.3	41.2	•	L_1	1990_1, 2021_1
1.B.2 CO_2 Emissions from Natural Gas Systems	CO_2	32.2	36.2	•	L_1	1990_1, 2021_1

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
1.A.3.c CO_2 Emissions from Transportation: Railways	CO_2	35.5	32.2	•	L_1	1990_1, 2021_1
1.B.2 CO_2 Emissions from Petroleum Systems	CO_2	9.5	24.7	•	L_1 T_1 T_2	2021_1
1.A.1 CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	97.5	17.7	•	L_1 T_1 L_2 T_2	1990, 2021_1
1.A.5 CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	19.5	17.0	•	L_1	1990_1
1.A.5.a CO_2 Emissions from Incineration of Waste	CO_2	12.9	12.5			
1.A.5.b CO_2 Emissions from Transportation: Military	CO_2	13.6	5.2	•	T_1	
1.A.5 CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2	0.0	3.9			
1.A.5 CO_2 Emissions from Stationary Combustion - Coal - U.S. Territories	CO_2	0.5	2.9			
1.B.1 CO_2 Emissions from Coal Mining	CO_2	4.6	2.5			
1.A.4.a CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2	12.0	1.4	•	T_1	
1.A.1 CO_2 Emissions from Stationary Combustion - Geothermal Energy	CO_2	0.5	0.4			
1.B.2 CO_2 Emissions from Abandoned Oil and Gas Wells	CO_2	+	+			
1.A.4.b CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2	3.0	0.0	•	T_2	
1.B.2 CH_4 Fugitive Emissions from Natural Gas Systems	CH_4	215.1	181.4	•	L_1 T_1 L_2 T_2	1990, 2021
1.B.2 CH_4 Fugitive Emissions from Petroleum Systems	CH_4	51.3	50.2	•	L_1 L_2	1990, 2021
1.B.1 CH_4 Fugitive Emissions from Coal Mining	CH_4	108.1	44.7	•	L_1 T_1 L_2 T_2	1990, 2021
1.B.2 CH_4 Fugitive Emissions from Abandoned Oil and Gas Wells	CH_4	7.7	8.2	•	L_2	1990_2, 2021_2
1.B.1 CH_4 Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	8.1	6.4			
1.A.4.b CH_4 Emissions from Stationary Combustion - Residential	CH_4	5.9	4.6	•	L_2 T_2	1990_2, 2021_2

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
1.A.2 CH_4 Emissions from Stationary Combustion - Industrial	CH_4	2.0	1.6			
1.A.4.a CH_4 Emissions from Stationary Combustion - Commercial	CH_4	1.2	1.3			
1.A.1 CH_4 Emissions from Stationary Combustion - Gas - Electricity Generation	CH_4	0.1	1.2			
1.A.3.e CO_2 Emissions from Transportation: Other	CH_4	0.8	1.1			
1.A.3.b CO_2 Emissions from Transportation: Road	CH_4	5.8	1.0			
1.A.3.d CO_2 Emissions from Transportation: Domestic Navigation	CH_4	0.4	0.5			
1.A.1 CH_4 Emissions from Stationary Combustion - Coal - Electricity Generation	CH_4	0.4	0.2			
1.A.3.c CO_2 Emissions from Transportation: Railways	CH_4	0.1	0.1			
1.A.5 CH_4 Emissions from Stationary Combustion - U.S. Territories	CH_4	+	+			
1.A.3.a CO_2 Emissions from Transportation: Aviation	CH_4	0.1	+			
1.A.1 CH_4 Emissions from Stationary Combustion - Wood - Electricity Generation	CH_4	+	+			
1.A.1 CH_4 Emissions from Stationary Combustion - Oil - Electricity Generation	CH_4	+	+			
1.A.5.b CO_2 Emissions from Transportation: Military	CH_4	+	+			
1.A.5.a CH_4 Emissions from Incineration of Waste	CH_4	+	+			
1.A.1 N_2O Emissions from Stationary Combustion - Coal - Electricity Generation	N_2O	17.9	15.1	•	L_2	1990_2, 2021_2
1.A.3.b N_2O Emissions from Transportation: Road	N_2O	32.2	9.4	•	L_1 T_1 L_2 T_2	1990
1.A.3.e N_2O Emissions from Transportation: Other	N_2O	4.2	5.6			
1.A.1 N_2O Emissions from Stationary Combustion - Gas - Electricity Generation	N_2O	0.3	3.9	•	T_2	
1.A.2 N_2O Emissions from Stationary Combustion - Industrial	N_2O	2.7	2.1			

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
1.A.3.a N_2O Emissions from Transportation: Aviation	N_2O	1.5	1.3			
1.A.4.b N_2O Emissions from Stationary Combustion - Residential	N_2O	0.9	0.7			
1.A.5.a N_2O Emissions from Incineration of Waste	N_2O	0.4	0.4			
1.A.4.a N_2O Emissions from Municipal Solid Waste	N_2O	0.3	0.3			
1.A.3.d N_2O Emissions from Transportation: Domestic Navigation	N_2O	0.2	0.3			
1.A.3.c N_2O Emissions from Transportation: Railways	N_2O	0.2	0.2			
1.A.5 N_2O Emissions from Stationary Combustion - U.S. Territories	N_2O	+	0.1			
1.B.2 N_2O Emissions from Petroleum Systems	N_2O	+	+			
1.A.1 N_2O Emissions from Stationary Combustion - Wood - Electricity Generation	N_2O	+	+			
1.B.2 N_2O Emissions from Natural Gas Systems	N_2O	+	+			
1.A.1 N_2O Emissions from Stationary Combustion - Oil - Electricity Generation	N_2O	0.1	+			
1.A.5.b N_2O Emissions from Transportation: Military	N_2O	+	+			
Industrial Processes and Product Use						
2.C.1 CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	104.7	41.7	•	L_1 T_1 L_2 T_2	1990, 2021
2.A.1 CO_2 Emissions from Cement Production	CO_2	33.5	41.3	•	L_1 T_1	1990_1, 2021_1
2.B.8 CO_2 Emissions from Petrochemical Production	CO_2	21.6	33.2	•	L_1 T_1	1990_1, 2021_1
2.B.1 CO_2 Emissions from Ammonia Production	CO_2	14.4	12.2			
2.A.2 CO_2 Emissions from Lime Production	CO_2	11.7	11.9			
2.A.4 CO_2 Emissions from Other Process Uses of Carbonates	CO_2	6.2	8.0			
2.B.10 CO_2 Emissions from Carbon Dioxide Consumption	CO_2	1.5	5.0			
2.B.10 CO_2 Emissions from Urea Consumption for Non-Ag Purposes	CO_2	3.8	5.0			

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
2.A.3 CO_2 Emissions from Glass Production	CO_2	1.9	2.0			
2.B.7 CO_2 Emissions from Soda Ash Production	CO_2	1.4	1.7			
2.C.2 CO_2 Emissions from Ferroalloy Production	CO_2	2.2	1.6			
2.C.3 CO_2 Emissions from Aluminum Production	CO_2	6.8	1.5			
2.B.6 CO_2 Emissions from Titanium Dioxide Production	CO_2	1.2	1.5			
2.C.6 CO_2 Emissions from Zinc Production	CO_2	0.6	1.0			
2.B.10 CO_2 Emissions from Phosphoric Acid Production	CO_2	1.5	0.9			
2.C.5 CO_2 Emissions from Lead Production	CO_2	0.5	0.4			
2.B.5 CO_2 Emissions from Silicon Carbide Production and Consumption	CO_2	0.2	0.2			
2.C.4 CO_2 Emissions from Magnesium Production and Processing	CO_2	0.1	+			
2.B.8 CH_4 Emissions from Petrochemical Production	CH_4	0.2	0.4			
2.C.2 CH_4 Emissions from Ferroalloy Production	CH_4	+	+			
2.B.5 CH_4 Emissions from Silicon Carbide Production and Consumption	CH_4	+	+			
2.C.1 CH_4 Emissions from Iron and Steel Production & Metallurgical Coke Production	CH_4	+	+			
2.B.2 N_2O Emissions from Nitric Acid Production	N_2O	10.8	7.9			
2.B.3 N_2O Emissions from Adipic Acid Production	N_2O	13.5	6.6	•	T_1	
2.G N_2O Emissions from Product Uses	N_2O	3.8	3.8			
2.B.4 N_2O Emissions from Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	1.5	1.2			
2.E N_2O Emissions from Electronics Industry	N_2O	+	0.3			
2.F.1 Emissions from Substitutes for Ozone Depleting Substances: Refrigeration and Air conditioning	HFCs, PFCs	+	139.1	•	L_1 T_1 L_2 T_2	2021

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
2.F.4 Emissions from Substitutes for Ozone Depleting Substances: Aerosols	HFCs, PFCs	0.2	17.7	•	L_1 T_1 L_2 T_2	2021
2.F.2 Emissions from Substitutes for Ozone Depleting Substances: Foam Blowing Agents	HFCs, PFCs	+	10.8	•	T_1	
2.F.3 Emissions from Substitutes for Ozone Depleting Substances: Fire Protection	HFCs, PFCs	0.0	2.8			
2.F.5 Emissions from Substitutes for Ozone Depleting Substances: Solvents	HFCs, PFCs	0.0	2.1			
2.G SF_6 and CF_4 Emissions from Electrical Transmission and Distribution	SF_6, CF_4	24.7	6.0	•	L_1 T_1 T_2	1990_1
2.E PFC, HFC, SF_6, and NF_3 Emissions from Electronics Industry	PFCs, HFCs, SF_6, NF_3	3.3	4.5			
2.B.9 HFC-23 Emissions from HCFC-22 Production	HFCs	38.6	2.2	•	L_1 T_1 T_2	1990_1
2.C.4 SF_6 Emissions from Magnesium Production and Processing	SF_6	5.4	1.1			
2.C.3 PFC Emissions from Aluminum Production	PFCs	19.3	0.9	•	L_1 T_1	1990_1
2.C.4 HFC-134a Emissions from Magnesium Production and Processing	HFCs	0.0	+			
Agriculture						
3.H CO_2 Emissions from Urea Fertilization	CO_2	2.4	5.2			
3.G CO_2 Emissions from Liming	CO_2	4.7	3.0			
3.A.1 CH_4 Emissions from Enteric Fermentation: Cattle	CH_4	176.1	188.2	•	L_1 T_1 L_2 T_2	1990, 2021
3.B.1 CH_4 Emissions from Manure Management: Cattle	CH_4	17.8	37.9	•	L_1 T_1 L_2 T_2	2021
3.B.4 CH_4 Emissions from Manure Management: Other Livestock	CH_4	21.3	28.1	•	L_1	1990_1, 2021_1
3.C CH_4 Emissions from Rice Cultivation	CH_4	17.9	16.8	•	L_1 L_2	1990, 2021_2
3.A.4 CH_4 Emissions from Enteric Fermentation: Other Livestock	CH_4	7.0	6.8			
3.F CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	0.4	0.5			
3.D.1 Direct N_2O Emissions from Agricultural Soil Management	N_2O	259.5	264.7	•	L_1 L_2 T_2	1990, 2021

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
3.D.2 Indirect N_2O Emissions from Applied Nitrogen	N_2O	28.5	29.3	•	L_1 L_2	1990, 2021
3.B.1 N_2O Emissions from Manure Management: Cattle	N_2O	9.9	13.8			
3.B.4 N_2O Emissions from Manure Management: Other Livestock	N_2O	2.5	3.6			
3.F N_2O Emissions from Field Burning of Agricultural Residues	N_2O	0.1	0.2			
Waste						
5.A CH_4 Emissions from MSW Landfills	CH_4	185.5	103.7	•	L_1 T_1 L_2 T_2	1990, 2021
5.A CH_4 Emissions from Industrial Landfills	CH_4	12.2	18.9	•	L_1 L_2 T_2	2021
5.D CH_4 Emissions from Domestic Wastewater Treatment	CH_4	16.5	13.9	•	L_2	1990_2
5.D CH_4 Emissions from Industrial Wastewater Treatment	CH_4	6.2	7.2			
5.B CH_4 Emissions from Composting	CH_4	0.4	2.6			
5.B.2 CH_4 Emissions from Anaerobic Digestion at Biogas Facilities	CH_4	+	0.2			
5.D N_2O Emissions from Domestic Wastewater Treatment	N_2O	14.4	20.4	•	L_1 L_2 T_2	1990_2, 2021
5.B N_2O Emissions from Composting	N_2O	0.3	1.8			
5.D N_2O Emissions from Industrial Wastewater Treatment	N_2O	0.4	0.5			

+ Absolute value does not exceed 0.05 MMT CO_2 Eq.

NO (Not Occurring)

[a] If the source is a key category for both L_1 and L_2 (as designated in the ID criteria column), it is a key category for both assessments in the years provided unless noted by a subscript, in which case it is a key category for that assessment in that year only (e.g., 1990_2 designates a category is key for the Approach 2 assessment only in 1990).

[b] Other includes emissions from pipelines.

Note: LULUCF sources and sinks are not included in the analysis presented in this table. See Table A-3 for the results of the analysis with LULUCF.

Table A-3: U.S. Greenhouse Gas Inventory Source Categories with LULUCF

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
Energy						
1.A.3.b CO_2 Emissions from Transportation: Road	CO_2	1,157.4	1,456.3	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.1 CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	1,546.5	909.9	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.1 CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	175.4	612.9	•	L_1 T_1 L_2 T_2	1990_1, 2021
1.A.2 CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	407.4	499.6	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.4.b CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	237.8	258.6	•	L_1 T_1 L_2	1990, 2021
1.A.2 CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	287.1	232.9	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.4.a CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	142.0	180.9	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.3.a CO_2 Emissions from Transportation: Aviation	CO_2	187.2	153.3	•	L_1 T_1 L_2	1990, 2021
1.A.5 CO_2 Emissions from Non-Energy Use of Fuels	CO_2	112.4	140.2	•	L_1 T_1 L_2 T_2	1990, 2021
1.A.3.e CO_2 Emissions from Transportation: Other	CO_2	36.0	64.2	•	L_1 T_1	1990_1, 2021_1
1.A.4.b CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	97.8	54.7	•	L_1 T_1 T_2	1990_1, 2021_1
1.A.4.a CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	74.3	50.7	•	L_1 T_1	1990_1, 2021_1
1.A.2 CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	157.8	43.0	•	L_1 T_1 L_2 T_2	1990, 2021_1
1.A.3.d CO_2 Emissions from Transportation: Domestic Navigation	CO_2	39.3	41.2	•	L_1	1990_1, 2021_1
1.B.2 CO_2 Emissions from Natural Gas Systems	CO_2	32.2	36.2	•	L_1	1990_1, 2021_1
1.A.3.c CO_2 Emissions from Transportation: Railways	CO_2	35.5	32.2	•	L_1	1990_1, 2021_1
1.B.2 CO_2 Emissions from Petroleum Systems	CO_2	9.5	24.7	•	L_1 T_1 T_2	2021_1

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
1.A.1 CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	97.5	17.7	•	L_1 T_1 T_2	1990_1, 2021_1
1.A.5 CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	19.5	17.0	•	L_1	1990_1
1.A.5.a CO_2 Emissions from Incineration of Waste	CO_2	12.9	12.5			
1.A.5.b CO_2 Emissions from Transportation: Military	CO_2	13.6	5.2	•	T_1	
1.A.5 CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2	-	3.9			
1.A.5 CO_2 Emissions from Stationary Combustion - Coal - U.S. Territories	CO_2	0.5	2.9			
1.B.1 CO_2 Emissions from Coal Mining	CO_2	4.6	2.5			
1.A.4.a CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2	12.0	1.4	•	T_1	
1.A.1 CO_2 Emissions from Stationary Combustion - Geothermal Energy	CO_2	0.5	0.4			
1.B.2 CO_2 Emissions from Abandoned Oil and Gas Wells	CO_2	0.0	+			
1.A.4.b CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2	3.0	0.0	•	T_2	
1.B.2 CH_4 Fugitive Emissions from Natural Gas Systems	CH_4	215.1	181.4	•	L_1 T_1 L_2 T_2	1990, 2021
1.B.2 CH_4 Fugitive Emissions from Petroleum Systems	CH_4	51.3	50.2	•	L_1	1990_1, 2021_1
1.B.1 CH_4 Fugitive Emissions from Coal Mining	CH_4	108.1	44.7	•	L_1 T_1 L_2 T_2	1990, 2021
1.B.2 CH_4 Fugitive Emissions from Abandoned Oil and Gas Wells	CH_4	7.7	8.2	•	L_2	1990_2, 2021_2
1.B.1 CH_4 Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	8.1	6.4			
1.A.4.b CH_4 Emissions from Stationary Combustion - Residential	CH_4	5.9	4.6	•	L_2 T_2	1990_2, 2021_2
1.A.2 CH_4 Emissions from Stationary Combustion - Industrial	CH_4	2.0	1.6			
1.A.4.a CH_4 Emissions from Stationary Combustion - Commercial	CH_4	1.2	1.3			

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
1.A.1 CH_4 Emissions from Stationary Combustion - Gas - Electricity Generation	CH_4	0.1	1.2			
1.A.3.e CO_2 Emissions from Transportation: Other	CH_4	0.8	1.1			
1.A.3.b CO_2 Emissions from Transportation: Road	CH_4	5.8	1.0			
1.A.3.d CO_2 Emissions from Transportation: Domestic Navigation	CH_4	0.4	0.5			
1.A.1 CH_4 Emissions from Stationary Combustion - Coal - Electricity Generation	CH_4	0.4	0.2			
1.A.3.c CO_2 Emissions from Transportation: Railways	CH_4	0.1	0.1			
1.A.5 CH_4 Emissions from Stationary Combustion - U.S. Territories	CH_4	0.0	+			
1.A.3.a CO_2 Emissions from Transportation: Aviation	CH_4	0.1	+			
1.A.1 CH_4 Emissions from Stationary Combustion - Wood - Electricity Generation	CH_4	0.0	+			
1.A.1 CH_4 Emissions from Stationary Combustion - Oil - Electricity Generation	CH_4	0.0	+			
1.A.5.b CO_2 Emissions from Transportation: Military	CH_4	0.0	+			
1.A.5.a CH_4 Emissions from Incineration of Waste	CH_4	0.0	+			
1.A.1 N_2O Emissions from Stationary Combustion - Coal - Electricity Generation	N_2O	17.9	15.1			
1.A.3.b N_2O Emissions from Transportation: Road	N_2O	32.2	9.4	•	L_1 T_1 T_2	1990_1
1.A.3.e N_2O Emissions from Transportation: Other	N_2O	4.2	5.6			
1.A.1 N_2O Emissions from Stationary Combustion - Gas - Electricity Generation	N_2O	0.3	3.9			
1.A.2 N_2O Emissions from Stationary Combustion - Industrial	N_2O	2.7	2.1			
1.A.3.a N_2O Emissions from Transportation: Aviation	N_2O	1.5	1.3			
1.A.4.b N_2O Emissions from Stationary Combustion - Residential	N_2O	0.9	0.7			

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
1.A.5.a N_2O Emissions from Incineration of Waste	N_2O	0.4	0.4			
1.A.4.a N_2O Emissions from Municipal Solid Waste	N_2O	0.3	0.3			
1.A.3.d N_2O Emissions from Transportation: Domestic Navigation	N_2O	0.2	0.3			
1.A.3.c N_2O Emissions from Transportation: Railways	N_2O	0.2	0.2			
1.A.5 N_2O Emissions from Stationary Combustion - U.S. Territories	N_2O	0.0	0.1			
1.B.2 N_2O Emissions from Petroleum Systems	N_2O	0.0	+			
1.A.1 N_2O Emissions from Stationary Combustion - Wood - Electricity Generation	N_2O	0.0	+			
1.B.2 N_2O Emissions from Natural Gas Systems	N_2O	0.0	+			
1.A.1 N_2O Emissions from Stationary Combustion - Oil - Electricity Generation	N_2O	0.1	+			
1.A.5.b N_2O Emissions from Transportation: Military	N_2O	0.0	+			
Industrial Processes and Product Use						
2.C.1 CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	104.7	41.7	•	L_1 T_1 L_2 T_2	1990, 2021
2.A.1 CO_2 Emissions from Cement Production	CO_2	33.5	41.3	•	L_1 T_1	1990_1, 2021_1
2.B.8 CO_2 Emissions from Petrochemical Production	CO_2	21.6	33.2	•	L_1 T_1	1990_1, 2021_1
2.B.1 CO_2 Emissions from Ammonia Production	CO_2	14.4	12.2			
2.A.2 CO_2 Emissions from Lime Production	CO_2	11.7	11.9			
2.A.4 CO_2 Emissions from Other Process Uses of Carbonates	CO_2	6.2	8.0			
2.B.10 CO_2 Emissions from Carbon Dioxide Consumption	CO_2	1.5	5.0			
2.B.10 CO_2 Emissions from Urea Consumption for Non-Ag Purposes	CO_2	3.8	5.0			
2.A.3 CO_2 Emissions from Glass Production	CO_2	1.9	2.0			
2.B.7 CO_2 Emissions from Soda Ash Production	CO_2	1.4	1.7			
2.C.2 CO_2 Emissions from Ferroalloy Production	CO_2	2.2	1.6			

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
2.C.3 CO_2 Emissions from Aluminum Production	CO_2	6.8	1.5			
2.B.6 CO_2 Emissions from Titanium Dioxide Production	CO_2	1.2	1.5			
2.C.6 CO_2 Emissions from Zinc Production	CO_2	0.6	1.0			
2.B.10 CO_2 Emissions from Phosphoric Acid Production	CO_2	1.5	0.9			
2.C.5 CO_2 Emissions from Lead Production	CO_2	0.5	0.4			
2.B.5 CO_2 Emissions from Silicon Carbide Production and Consumption	CO_2	0.2	0.2			
2.C.4 CO_2 Emissions from Magnesium Production and Processing	CO_2	0.1	+			
2.B.8 CH_4 Emissions from Petrochemical Production	CH_4	0.2	0.4			
2.C.2 CH_4 Emissions from Ferroalloy Production	CH_4	0.0	+			
2.B.5 CH_4 Emissions from Silicon Carbide Production and Consumption	CH_4	0.0	+			
2.C.1 CH_4 Emissions from Iron and Steel Production & Metallurgical Coke Production	CH_4	0.0	+			
2.B.2 N_2O Emissions from Nitric Acid Production	N_2O	10.8	7.9			
2.B.3 N_2O Emissions from Adipic Acid Production	N_2O	13.5	6.6	•	T_1	
2.G N_2O Emissions from Product Uses	N_2O	3.8	3.8			
2.B.4 N_2O Emissions from Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	1.5	1.2			
2.E N_2O Emissions from Electronics Industry	N_2O	0.0	0.3			
2.F.1 Emissions from Substitutes for Ozone Depleting Substances: Refrigeration and Air conditioning	HFCs, PFCs	0.0	139.1	•	L_1 T_1 L_2 T_2	2021
2.F.4 Emissions from Substitutes for Ozone Depleting Substances: Aerosols	HFCs, PFCs	0.2	17.7	•	L_1 T_1 L_2 T_2	2021
2.F.2 Emissions from Substitutes for Ozone Depleting Substances: Foam Blowing Agents	HFCs, PFCs	0.0	10.8	•	T_1	

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
2.F.3 Emissions from Substitutes for Ozone Depleting Substances: Fire Protection	HFCs, PFCs	-	2.8			
2.F.5 Emissions from Substitutes for Ozone Depleting Substances: Solvents	HFCs, PFCs	-	2.1			
2.G SF_6 and CF_4 Emissions from Electrical Transmission and Distribution	SF_6, CF_4	24.7	6.0	•	L_1 T_1 T_2	1990_1
2.E PFC, HFC, SF_6, and NF_3 Emissions from Electronics Industry	PFCs, HFCs, SF_6, NF_3	3.3	4.5			
2.B.9 HFC-23 Emissions from HCFC-22 Production	HFCs	38.6	2.2	•	L_1 T_1 T_2	1990_1
2.C.4 SF_6 Emissions from Magnesium Production and Processing	SF_6	5.4	1.1			
2.C.3 PFC Emissions from Aluminum Production	PFCs	19.3	0.9	•	L_1 T_1	1990_1
2.C.4 HFC-134a Emissions from Magnesium Production and Processing	HFCs	-	+			
Agriculture						
3.H CO_2 Emissions from Urea Fertilization	CO_2	2.4	5.2			
3.G CO_2 Emissions from Liming	CO_2	4.7	3.0			
3.A.1 CH_4 Emissions from Enteric Fermentation: Cattle	CH_4	176.1	188.2	•	L_1 T_1 L_2	1990, 2021
3.B.1 CH_4 Emissions from Manure Management: Cattle	CH_4	17.8	37.9	•	L_1 T_1 T_2	2021_1
3.B.4 CH_4 Emissions from Manure Management: Other Livestock	CH_4	21.3	28.1	•	L_1 T_1	1990_1, 2021_1
3.C CH_4 Emissions from Rice Cultivation	CH_4	17.9	16.8	•	L_2	1990_2, 2021_2
3.A.4 CH_4 Emissions from Enteric Fermentation: Other Livestock	CH_4	7.0	6.8			
3.F CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	0.4	0.5			
3.D.1 Direct N_2O Emissions from Agricultural Soil Management	N_2O	259.5	264.7	•	L_1 L_2 T_2	1990, 2021
3.D.2 Indirect N_2O Emissions from Applied Nitrogen	N_2O	28.5	29.3	•	L_1 L_2	1990, 2021
3.B.1 N_2O Emissions from Manure Management: Cattle	N_2O	9.9	13.8			
3.B.4 N_2O Emissions from Manure Management: Other Livestock	N_2O	2.5	3.6			
3.F N_2O Emissions from Field Burning of Agricultural Residues	N_2O	0.1	0.2			
Waste						

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
5.A CH_4 Emissions from MSW Landfills	CH_4	185.5	103.7	•	L_1 T_1 L_2 T_2	1990, 2021
5.A CH_4 Emissions from Industrial Landfills	CH_4	12.2	18.9	•	L_1 T_2	2021_1
5.D CH_4 Emissions from Domestic Wastewater Treatment	CH_4	16.5	13.9			
5.D CH_4 Emissions from Industrial Wastewater Treatment	CH_4	6.2	7.2			
5.B CH_4 Emissions from Composting	CH_4	0.4	2.6			
5.B.2 CH_4 Emissions from Anaerobic Digestion at Biogas Facilities	CH_4	+	0.2			
5.D N_2O Emissions from Domestic Wastewater Treatment	N_2O	14.4	20.4	•	L_1 L_2 T_2	1990_2, 2021
5.B N_2O Emissions from Composting	N_2O	0.3	1.8			
5.D N_2O Emissions from Industrial Wastewater Treatment	N_2O	0.4	0.5			
Land Use, Land Use Change, and Forestry						
4.E.2 Net CO_2 Emissions from Land Converted to Settlements	CO_2	62.5	81.0	•	L_1 T_1 L_2 T_2	1990, 2021
4.B.2 Net CO_2 Emissions from Land Converted to Cropland	CO_2	54.8	56.5	•	L_1 L_2	1990, 2021
4.C.1 Net CO_2 Emissions from Grassland Remaining Grassland	CO_2	8.7	10.0	•	L_2 T_2	1990_2, 2021_2
4.D.2 Net CO_2 Emissions from Lands Converted to Wetlands	CO_2	1.9	0.3			
4.D.1 Net CO_2 Emissions from Coastal Wetlands Remaining Coastal Wetlands	CO_2	(7.4)	(8.1)			
4.B.1 Net CO_2 Emissions from Cropland Remaining Cropland	CO_2	(23.2)	(18.9)	•	L_1 L_2 T_2	1990, 2021
4.C.2 Net CO_2 Emissions from Land Converted to Grassland	CO_2	(6.7)	(24.7)	•	L_1 T_1 L_2 T_2	1990_2, 2021
4.A.2 Net CO_2 Emissions from Land Converted to Forest Land	CO_2	(98.5)	(98.3)	•	L_1 L_2	1990, 2021
4.E.1 Net CO_2 Emissions from Settlements Remaining Settlements	CO_2	(109.6)	(134.5)	•	L_1 T_1 L_2 T_2	1990, 2021
4.A.1 Net CO_2 Emissions from Forest Land Remaining Forest Land	CO_2	(821.4)	(695.4)	•	L_1 T_1 L_2 T_2	1990, 2021
4.D.1 CH_4 Emissions from Flooded Lands Remaining Flooded Lands	CH_4	44.6	45.4	•	L_1	1990_1, 2021_1
4.A.1 CH_4 Emissions from Forest Fires	CH_4	3.2	15.5	•	T_1 T_2	

CRF Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2021 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
4.D.1 CH_4 Emissions from Coastal Wetlands Remaining Coastal Wetlands	CH_4	4.2	4.3			
4.C.1 CH_4 Emissions from Grass Fires	CH_4	0.1	0.3			
4.D.2 CH_4 Emissions from Land Converted to Coastal Wetlands	CH_4	0.3	0.2			
4.D.2 CH_4 Emissions from Land Converted to Flooded Lands	CH_4	1.1	0.2			
4.A.4 CH_4 Emissions from Drained Organic Soils	CH_4	0.0	+			
4.D.1 CH_4 Emissions from Peatlands Remaining Peatlands	CH_4	0.0	+			
4.A.1 N_2O Emissions from Forest Fires	N_2O	2.3	8.9	•	T_2	
4.E.1 N_2O Emissions from Settlement Soils	N_2O	1.8	2.1			
4.A.1 N_2O Emissions from Forest Soils	N_2O	0.1	0.4			
4.C.1 N_2O Emissions from Grass Fires	N_2O	0.1	0.3			
4.D.1 N_2O Emissions from Coastal Wetlands Remaining Coastal Wetlands	N_2O	0.1	0.1			
4.A.4 N_2O Emissions from Drained Organic Soils	N_2O	0.1	0.1			
4.D.1 N_2O Emissions from Peatlands Remaining Peatlands	N_2O	0.0	+			

+ Absolute value does not exceed 0.05 MMT CO_2 Eq.

NO (Not Occurring)

[a] If the source is a key category for both L_1 and L_2 (as designated in the ID criteria column), it is a key category for both assessments in the years provided unless noted by a subscript, in which case it is a key category only for that assessment in only that year (e.g., 1990_2 designates a category is key for the Approach 2 assessment only in 1990).

[b] Other includes emissions from pipelines.

Note: Parentheses indicate negative values (or sequestration).

Approach for Evaluation of Key Categories

Level Assessment

When using an Approach 1 for the level assessment, a predetermined cumulative emissions threshold is used to identify key categories, consistent with the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2006) and the *2019 Refinement to the 2006 IPCC Guidelines (IPCC 2019)*. When source and sink categories are sorted in order of decreasing absolute emissions, those that fall at the top of the list and cumulatively account for 95 percent of emissions are considered key categories. The 95 percent threshold in the *2006 IPCC Guidelines* was designed to establish a general level where the key category analysis covers approximately 90 percent of inventory uncertainty.

Including the Approach 2 provides additional insight into why certain source and sink categories are considered key, and how to prioritize inventory improvements to reduce overall uncertainties. In the Approach 2, the level assessment for each category from the Approach 1 is multiplied by its percent relative uncertainty. Per the *2006 IPCC Guidelines*, if the uncertainty reported is asymmetrical, the absolute value of the larger uncertainty is used. When source and sink

categories are sorted in decreasing order of this calculation, those that fall at the top of the list and cumulatively account for 90 percent of emissions are considered key categories. The key categories identified by the Approach 2 level assessment may differ from those identified by the Approach 1 assessment. The final set of key categories includes all source and sink categories identified as key by either the Approach 1 or the Approach 2 assessment (as noted in Table A-1), keeping in mind that the two assessments are not mutually exclusive. The uncertainty associated with CO_2 from mobile combustion is applied to each mode's emission estimate. Note, an uncertainty analysis was conducted for the CO_2 and N_2O emissions from waste incineration but has not yet been conducted for the CH_4 emissions from waste incineration because the estimate is near zero.

It is important to note that a key category analysis can be sensitive to the definitions of the source and sink categories. If a large source or sink category is split into many subcategories, then the subcategories may have contributions to the total inventory that are too small for those source categories to be considered key. Similarly, a collection of small, non-key source categories adding up to less than 5 percent of total emissions could become key source categories if those source categories were aggregated into a single source or sink category. The United States has attempted to define source and sink categories by the conventions that would best inform improvement prioritization and still allow comparison with other international key category analyses, so still maintaining the category definitions that constitute how the emissions estimates were calculated for this report. As such, some of the category names used in the key category analysis may differ from the names used in the main body of the report. Additionally, the United States accounts for some source categories, including fossil fuel feedstocks, international bunkers, and emissions from U.S. Territories, that are derived from unique data sources using country-specific methodologies. Consistent with UNFCCC reporting guidelines, the level and trend assessments using Approach 1 and Approach 2 are applied including and excluding the LULUCF sector to assess significance of this sector and comprehensively identify key categories that would not have been identified as key given the significance LULUCF sector.

Table KCA-1 through Table KCA-4 contain the 1990 and 2021 level assessments for both with and without LULUCF sources and sinks, and contain further detail on where each source falls within the analysis.[1] In the tables, Approach 1 key categories are shaded dark gray. Additional key categories identified by the Approach 2 assessment are shaded light gray.

Trend Assessment

Approach 1 for trend assessment is defined as the product of the source or sink category level assessment and the absolute difference between the source or sink category trend and the total trend. In turn, the source or sink category trend is defined as the change in emissions or removals from the base year to the current year, as a percentage of current year inventory estimate from that source or sink category. The total trend is the percentage change in total inventory estimate from the base year to the current year.

Thus, the source or sink category trend assessment will be large if the source or sink category represents a large percentage of emissions and/or has a trend that is quite different from the overall inventory trend. To determine key categories, the trend assessments are sorted in descending order, so that the source or sink categories with the highest trend assessments appear first. The trend assessments are summed until the threshold of 95 percent is reached; all categories that fall within that cumulative 95 percent are considered key categories.

For Approach 2, the trend assessment for each category from Approach 1 is multiplied by its percent relative uncertainty. If the uncertainty reported is asymmetrical, the larger uncertainty is used. When source and sink categories are sorted in decreasing order of this calculation, those that fall at the top of the list and cumulatively account for 90 percent of emissions are considered key categories. The key categories identified by the Approach 2 trend assessment may differ from those identified by the Approach 1 assessment. The final set of key categories includes all source and sink categories identified as key by either the Approach 1 or the Approach 2 assessment, keeping in mind that the two assessments are not mutually exclusive.

Table KCA-5 through Table KCA-6 contain the trend assessments with and without LULUCF sources and sinks, and contain further detail on where each source falls within the analysis.[2] In the tables, similar to the Approach 1 and 2 level

[1] Tables are available online at: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021.

[2] Tables are available online at: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021.

assessment tables, the Approach 1 trend assessment key categories are shaded dark gray. Additional key categories identified by the Approach 2 assessment are shaded light gray.

References

IPCC (2019) *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.* The Intergovernmental Panel on Climate Change. [Buendia, E., Guendehou S., Limmeechokachai B., Pipatti R., Rojas Y., Sturgiss R., Tanabe K., Wirth T., (eds.)]. Cambridge University Press. In Press.

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